Operating and Service Manual

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FREQUENCY CONVERTER

MODEL 13-4618-20

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FREQUENCY CONVERTER

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

Gould Frequency Converter, Model 13-4618-20, is a fully input-isolated converter which produces 0 to 5 vdc voltage proportional to an input signal frequency sensed on the input. It is designed to send any input frequency from 0 to 50KHz at a signal level of 10mvrms to 500Vrms. An input offset control adjusts the minimum input trigger level from 0 to ±1vdc to insure that TTL signals across zero and are sensed by the converter. A second input circuit is provided to enable use of an externally located optical coupler. An LED drive current of approximately 50ma is available at the input connector. When this auxiliary input is used, terminals 1 and 3 of J-101 are simply shorted together.

Calibrated controls allow the output voltage to represent any of nine preset ranges from 10Hz full scale to 50KHz full scale. By utilizing zero suppression and range expansion features, it is possible to represent a portion of the selected range and display it across the full output range. This is fully explained in the section in Operation in this manual.

In addition to calibrated operation described above, a variable sensitivity feature enables the converter full scale output to represent any desired frequency within 40% to 100% of indicated range of the Converter. Refer to Operation section.

This signal conditioner is designed for use with any 2000 Series Recorder or other recording device with 100Kohm input impedance. Frequency Converter can be mounted in a Gould Preamplifier Frame, Carrying Case or preamplifier slot in a 2000 Series Recorder. Operating voltages required are ±15vdc and 12.6vrms.

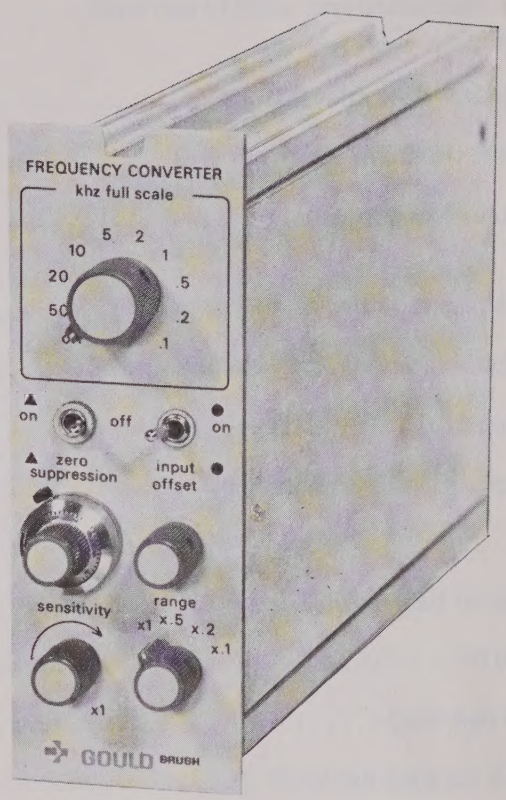


FIGURE 1-1 FREQUENCY CONVERTER

1.2 SPECIFICATIONS

a. Physical Characteristics

Dimensions: ..... 6.09" High x 10.88" long x 2.18" wide (15.3cm x 28cm x 5.6cm)

Weight: ..... 3.08 lbs. (1.4Kg)

Mounting ..... Retained from rear

Finish ..... Molded front panel – light parchment

b. Converter Input

Input No. 1

Configuration ..... Single ended floating (1500 volt isolation to Chassis)

Impedance ..... 100K ohm ±1%

Input Voltage ..... 10mv rms to 500V rms (Automatic Range)
±10mv trigger level

Maximum Safe Voltage ..... 700 volts peak A.C. or D.C.

Frequency Input ..... 10Hz ~~Full Scale~~ to 50KHz full sacle.

Input Offset Voltage ..... ±1V front panel adjustable.

Input No. 2

Configuration ..... For use with optical couplers.

Available Led Current ..... 12 volts @ 50ma ±10% short circuit current.

Current Sink Requirement ..... 0.12 ma ±10%

Frequency Response ..... Compatible with optical coupler.

c. Converter Output

Configuration ..... Single ended to common

Output Voltage ..... 0 to 5Vdc

Output Impedance ..... Less than 5 ohms

Calibration Inaccuracy ..... ±.1% of full scale on X1 range

Range Inaccuracy ..... ±.2%

Linearity ..... Within .1% of full scale

Instability (15 Min. Warmup)

	Zero	Gain
Time:	±.02% FS/24 Hr.	±.02%/24 Hr.
Temp:	±.02% FS/°C	±.08%/°C
Line Change (±10%):	±.10% FS	±.01% reading

Rise Time (10% to 90% Full Scale, < 2% overshoot) ..... .1, .2 and .5 KHz < 200ms
1, 2 and 5 KHz < 20ms
10, 20 and 50KHz < 2ms

Zero Suppression ..... 0 to 100%

Non-Linearity ..... ±.5% of F.S.

Common Mode Rejection (60Hz @ 1 Kohm imbalance) ..... 80db at 60Hz

Noise (10% Signal) ..... 1% on X1 Range

NOTE: SPECS DO NOT APPLY BELOW 10% OF F.S. SETTING.

d. Controls and Connectors

1) Front Panel

KHz Full Scale Switch	10 position 1, 2, 5 sequence to 50KHz and Off.
Zero Suppression Switch	ON/OFF activates zero suppression control.
Zero Suppression Control	10 Turn pot 0 to 100% suppression
Input Offset Switch	ON/OFF activates offset control
Sensitivity Control	1 turn pot reduces output by 60%
Range Switch	4 Position multiplies F.S. range.

2) Internal Controls

Output Zero	Adjusts output to zero in off position
Offset Zero	Adjusts 10% F.S. Signal to ±.5V dc
Gain	Adjusts 100% F.S. signal to +5.0V dc
Damping	Adjust rise time for critical damping
Symmetry	Adjust rise & fall time to be equal
Noise	Balances Loop for minimum noise

3) Rear Panel Connectors

Inputs	Guarded Multipin connector Model 11-5407-03
Output and Power	16 Pin card edge connector

e. Environment

Temperature Storage	-40 to 70°C
Operating	0 to 50°C
Humidity (Non-Condensing) 95% relative Humidity	0 to 30°C
Vibration and Shock	Best Commercial Practice

f. Power Requirements

DC Voltage	±15 volts ±.5 volts @ .1A
AC Voltage	12.6V rms @ .2A

g. System Specifications

Gain Accuracy ..... ±.3%

Non-Linearity ..... ±.45%

Instability

	Zero	Gain
Time:	±.12% FS/24 Hr.	±.12%/24 Hr.
Temp:	±.045% FS/°C	±.13%/°C
±10% Line Change:	±.2% FS	±.51%

Rise Time ..... See Converter Specifications

Noise ..... <5mv on X1 Range

SECTION II

INSTALLATION

2.1 GENERAL

This section describes inspection checks to be made upon receipt of Gould Frequency Converter, Model 13-4618-20 with a 2000 Series Recorder. It covers installation procedures, signal and power connections and dimensions.

2.2 INITIAL INSPECTION

Prior to attempting any electrical connections or operation visually examine the unit for broken or loose knobs, dented or nicked panels and broken or chipped rear connectors.

2.3 INSTALLATION

Preamplifier Model 13-4618-20 may be mounted in Gould 2000 Recorder frames, or mounted separately in a Gould rack adapter kit or portable carrying case.

a. Insertion

To install the preamplifier into its appropriate slot:

1. Slide the preamplifier into the enclosure until the rear output card edge connector is engaged.

2. Tighten the rear retaining screw. This locks the preamplifier into the enclosure.

3. Connect the plastic input signal connector and secure it by turning the threaded plastic locking ring clockwise.

b. Removal

1. Disconnect the input connections with a counterclockwise turn and pull.

2. Loosen the rear retaining screw. The preamplifier will move forward about 1/8 of an inch.

3. Carefully slide the entire preamplifier out of the Gould 2000 enclosure.

2.4 SIGNAL CONNECTIONS

This converter has a single ended floating input. Input and output are isolated from chassis, as well as from each other. Two options are available for input signal connections: using the internal optical isolation circuit or making connection to a customer furnished external optical isolator.

a. Internal Optical Coupler

Using a good two conductor shielded cable, connect signal leads to pins 1 and 2 of P-101 (Model 11-5407-03), furnished with unit. Cable shield should be soldered to shell around pins 1 and 2. Pins 6 and 7 of P-101 must be shorted together. See Figure 2-2.

b. External Optical Coupler

Provision is made for use of an external optical coupler. When using this input, pins 1 and 3 of J-101 must be shorted together. Pins 5 and 6 of J-101 supply approximately 50ma drive current to energize the optical coupler diode. Pins 6 and 7 of J-101 are connected to the light sensitive transistor of the coupler. Note that pin 6 is negative with respect to pin 7 and pin 5 is negative with respect to pin 4. See Figure 2-3.

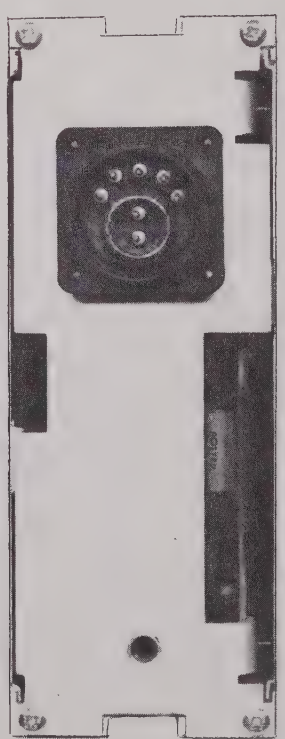


FIGURE 2-1 REAR VIEW

c. Output and Power

The amplifier is designed to operate on + and -15 volt 100ma regulated supplies, and 13vrms, 60Hz sine wave at 200 ma current. Output and power connections are provided through an 8 pin card edge connector on the rear of the preamp. (Figure 2-1). The mating connector is located in the recorder chassis.

The preamplifier provides a 5 volt full scale signal to the recorder.

2.5 OUTLINE DIMENSIONS

Refer to Figure 2-4 for outline dimensions.

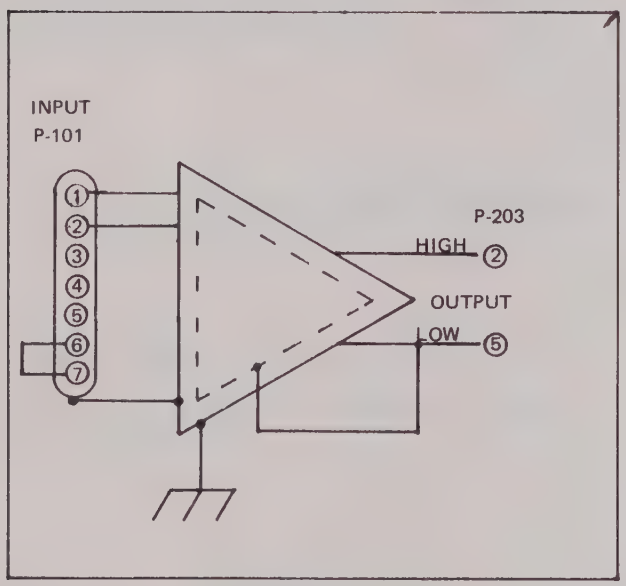


FIGURE 2-2 INTERNAL COUPLER SIGNAL CONNECTIONS

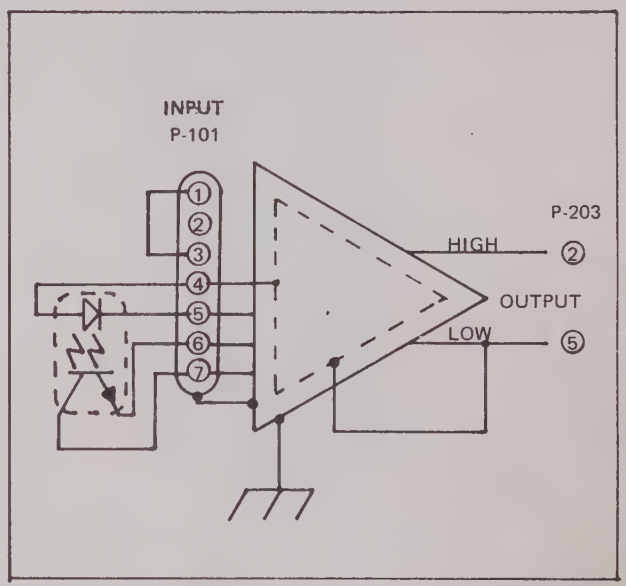


FIGURE 2-3 EXTERNAL COUPLER SIGNAL CONNECTIONS

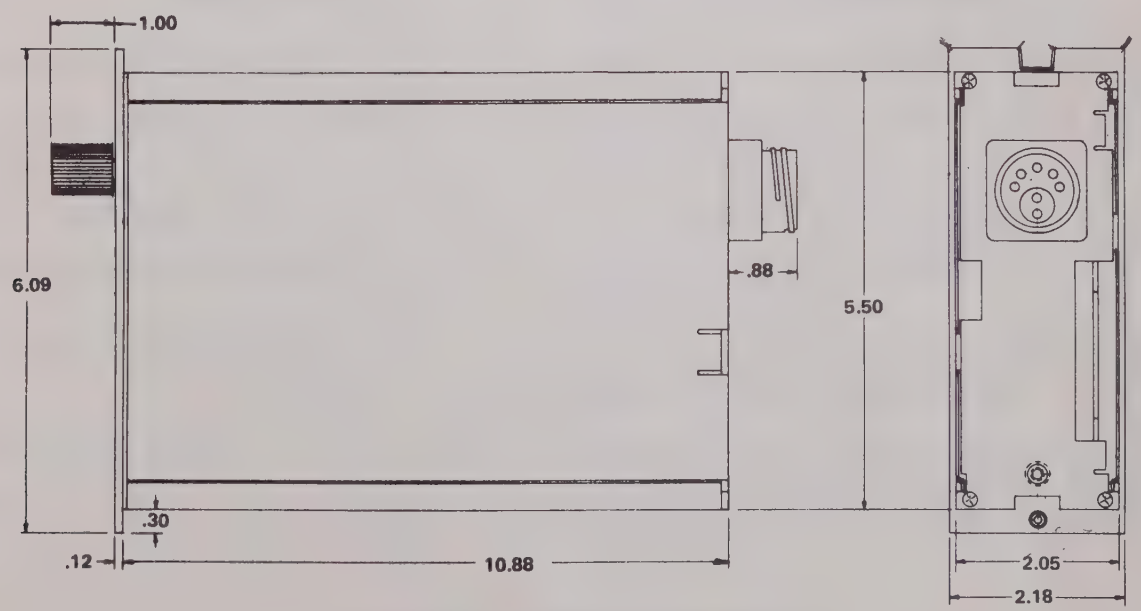


FIGURE 2-4 OUTLINE DIMENSIONS

SECTION III

OPERATION

3.1 GENERAL

This section describes and illustrates the controls of the Gould Model 13-4618-20 Frequency Converter and provides instructions for proper operation. Before attempting to use the amplifier it is imperative that the operator completely understand the functioning of the controls and the required input/output specifications.

3.2 FRONT PANEL CONTROLS

The items listed below correspond to controls shown in Figure 3-1.

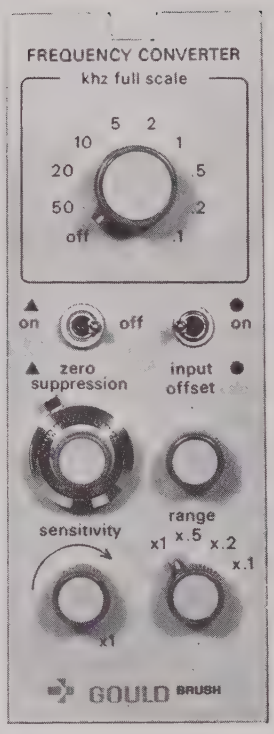


FIGURE 3-1 FRONT PANEL

CONTROL	DESCRIPTION
KHz Full Scale Switch (S-201)	Determines what input frequency will yield a full scale (5V output). Any frequency below that is given as a proportion of the full scale output.
Zero Suppression Switch (S-102)	On-Off switch activates zero suppression control.
Zero Suppression Control (R-103)	Calibrated control which suppresses from 0% to 100% of output signal.
Input Offset Switch (S-101)	On-Off switch activates input offset control.
Input Offset Control (R-102)	Single turn control which adjusts minimum trigger level from 0 to $\pm$1vdc.
Sensitivity Control (R-104)	When fully clockwise, output is calibrated. In other positions, attenuates output up to 60%.
Range Switch (S-103)	Allows expansion of the frequency range about the suppressed signal output. E.g., In 10KHz full scale, Range switch placed to X.2 will give full scale range of 2 KHz.

3.3 INTERNAL CONTROLS

CONTROL	DESCRIPTION
Output Zero (R-211)	Adjusts output to zero when Converter is OFF.
Offset Zero (R-228)	Adjusts output to +0.5vdc for 10% of full scale input.
Gain (R-227)	Adjusts output to +5.0vdc for 100% full scale input.
Damping (R-221)	Adjusts rise time for critical damping.
Symmetry (R-219)	Adjusts for equal rise and fall time.
Noise (R-220)	Balances phase lock loop for minimum noise.
Input Bias (R-203)	Adjusts input bias level to insure proper operation with a minimum input signal of ±10mv from a zero level.
Suppression (R-205)	Sets voltage to R-103 to proper level for calibrated zero suppression circuit.

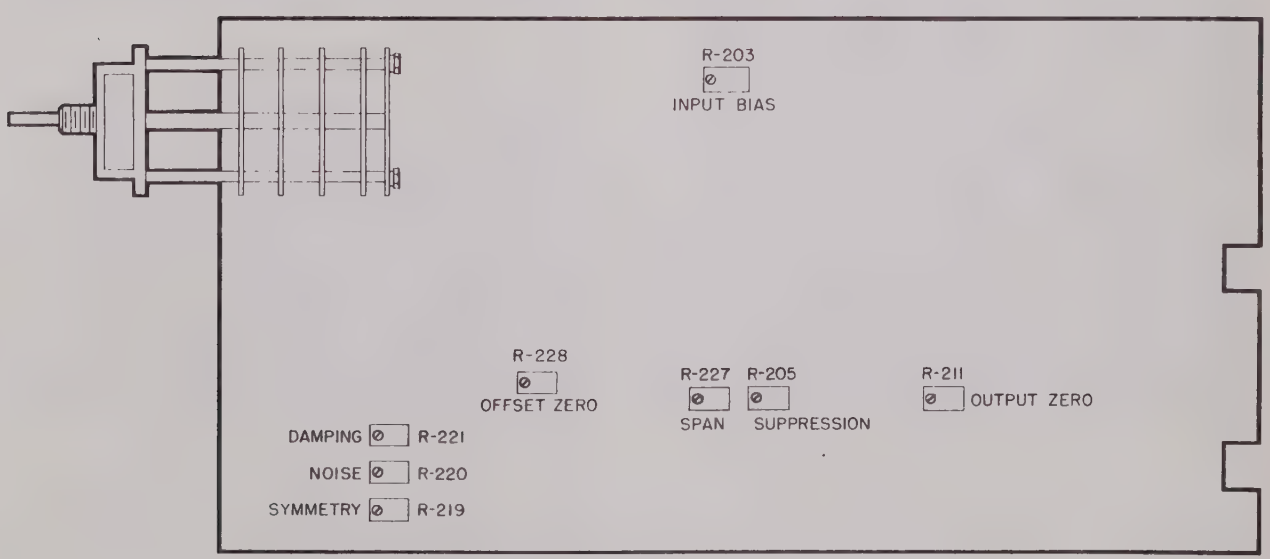


FIGURE 3-2 INTERNAL CONTROLS

3.4 OPERATION

CAUTION: ALL PROCEDURES OUTLINED IN SECTION II, INSTALLATION SHOULD BE COMPLETE BEFORE ATTEMPTING OPERATION OF THIS UNIT.

a. General

Before applying any signals to the input of this amplifier, set RANGE switch to the X1 position. With the KHz Full Scale switch in the OFF position, set the recorder pen position to right chart edge.

Move the Full scale sensitivity switch to the most sensitive position which still displays the entire output (i.e., does not cause the output to go off-scale).

b. Zero Suppression and Expanded Range

To use calibrated zero suppression, follow step a., above. Next note frequency applied and turn Zero Suppression switch ON. Rotate vernier control clockwise to suppress all but 5% of signal output. Placing RANGE switch to a lower setting will amplify the remaining signal and increase resolution.

EXAMPLE: Input frequency is 16 KHz and can vary between 15 KHz and 17 KHz. With KHz FULL SCALE to the 20 position and Zero Suppression OFF, pen will deflect 80% left of right edge. Calculating what percentage of full scale 15 KHz (the lowest frequency possible) is, it is found to be 75%. Turn zero suppression ON and dial in 7.50 on the vernier control. This moves the 16 KHz center frequency to 5% of full scale. The variation around this frequency is still $\pm$1 KHz. Now, move the RANGE Switch from X1 to X.1. The KHz full scale is now (20KHz) (.1) = 2 KHz. The 16 KHz center frequency moves from 5% of full scale to 50% full scale and the $\pm$1 KHz variation will cause deflection to left chart edge for +1 KHz (17 KHz) or right chart edge for -1 KHz (15 KHz).

c. Input Offset

This converter senses the input frequency for the occurrence of a zero crossing in a positve direction. If the input comes close but does not cross zero, an input offset control is provided to bias the input +1 vdc and insure that the signal then crosses zero. If the input is no closer than 1 vdc off-ground, the converter will not sense the signal. It is not necessary that the input be symmetrical about zero, only that it cross zero at some point in the waveform.

d. Variable Sensitivity

In addition to the calibrated mode of operation previously described, it is possible to operate this unit for a full scale output of any frequency within the operating range of the converter.

EXAMPLE: It is desired to measure frequencies between 0 KHz and 6 KHz. Rather than using 10 KHz Full Scale setting, which would utilize only 60% of full scale, place Frequency Full Scale switch to 5 KHz position. Rotate SNESITIVITY potentiometer CCW until known input (6 KHz) places pen on left chart edge. Now the entire chart is utilized and a 50% full scale reading equals 3 KHz input, 25% reading equals 1.5KHz, etc. Zero Suppression and Range Expansion features can still be used, but keep in mind that calibration factors are now referenced to a 6 KHz Full Scale limit and not 5 KHz Full Scale, as indicated. After tests are completed, place Sensitivity control back to X1 (detent) position to avoid misleading indications when the Frequency Converter is next used.

SECTION IV

MAINTENANCE

4.1 GENERAL

In addition to maintenance procedures, this section contains information on calibration and troubleshooting.

4.2 MAINTENANCE

a. General

Maintenance on the preamplifier is limited to cleaning only.

b. General Cleaning

CAUTION

1) **Before attempting to clean the preamp, turn power off and remove from enclosure.**
2) **Avoid use of chemical cleaning agents which might damage plastic or printed surfances. Do not use chemicals which contain toluene, cellusolve, acetone or similar solvents.**

EXTERIOR: Remove loose dust with a soft cloth or small paint brush. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. DO NOT USE ABRASIVE CLEANERS.

INTERIOR: Dust in the interior should be removed occasionally due to its electrical conductivity under high humidity conditions. Blow off accumulated dust with dry low pressure air. Remove any dirt which remains with a soft paint brush or a soft cloth dampened in a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces and/or printed circuit boards.

4.3 TROUBLESHOOTING

Troubleshooting may be performed in conjunction with the STAR and Schematic diagrams and the following test equipment:

Signal Generator Wavetek Model 111 or equiv.
Oscilloscope, Tektronix Model 453 or equiv.

4.4 STAR DIAGRAM

In order to facilitate troubleshooting of Gould Model 13-4618-20 Frequency Converter, the following Signal Tracing And Replacement (STAR) Diagram is included. A STAR diagram is a block diagram, expanded to include certain wiring diagram information, schematic diagram information and engineering maintenance information (signal levels, waveforms, test points, etc.). Initially, this diagram can be used in conjunction with the Theory of Operatin in Section V of this manual. As service personnel gain familiarity and experience with the equipment, the need to refer to the supporting descriptive text will gradually be eliminated.

The STAR diagram provides the essential information required to isolate a fault to a functional block. To use the STAR diagram, perform the preliminary setup procedure below. Then, by applying the scope probe to each test point, proceed through the unit until the signal you obtain is different from the information on the diagram for that test point. Having done this, the block immediately prior to the "bad" test point indicates in which area the trouble lies. Going to that area on the board (and the schematic), components may be checked to find the failure. Be sure to verify that all power supply voltages are present and correct (Sheet 1 of Diagram).

1. Set Front Panel Controls as follows:
   KHz Full Scale — OFF
   Zero Suppression Switch — OFF
   Zero Suppression Control—Fully CCW to 0.00
   Input Offset Switch — OFF
   Sensitivity Control — Fully CW to X1 (detent)
   Range Switch — X1
2. Connect a 2K ohm resistor across output pins 2 and 5 of printed circuit edge connector.
3. Remove unit right side cover.
4. Connect input to power source: +15vdc and 13vrms or power from a Gould 2000 Series Recorder and extender cable.
5. Allow unit to warm up for 15 minutes.
6. Apply 8 KHz sine wave signal of at least 1vrms amplitude.
7. Place KHz Full Scale Switch to 10 position.
8. Set oscilloscope to DC coupling, 100mv/cm and 50usec/cm. Probe should be 10:1 attenuator type.
9. Proceed to troubleshoot unit.

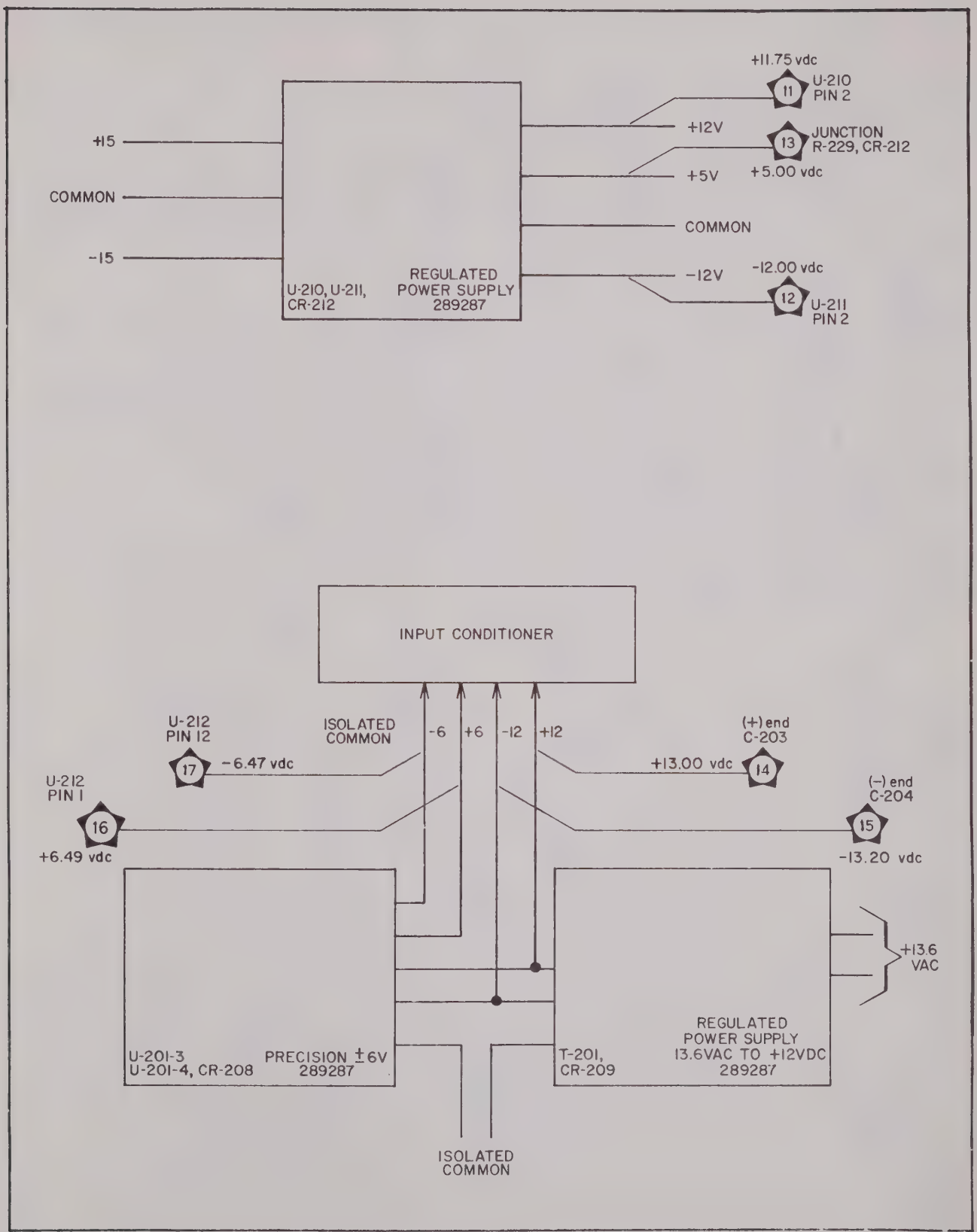


FIGURE 4-1 STAR DIAGRAM (Sheet 1 of 2)

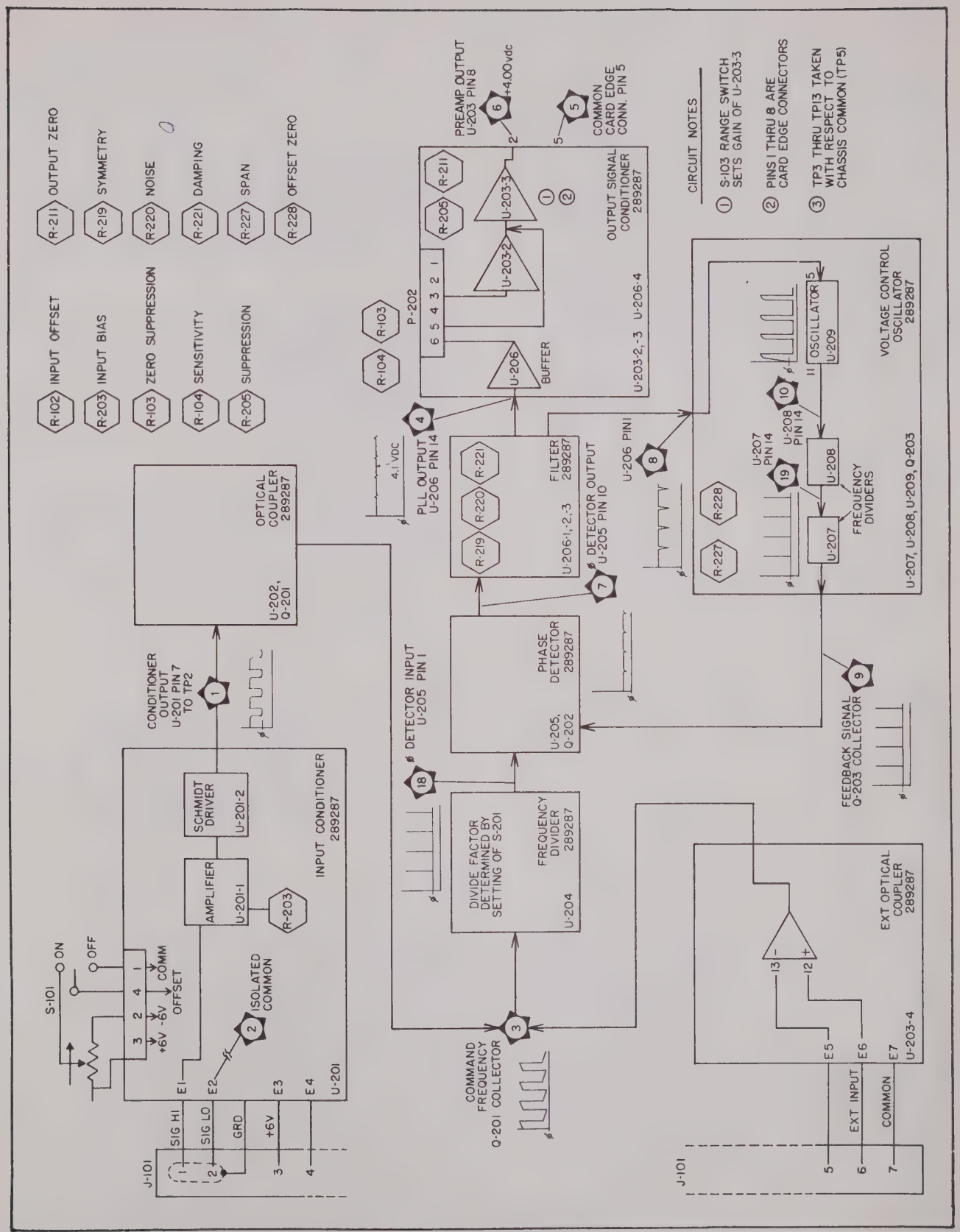


FIGURE 4-1 STAR DIAGRAM (Sheet 2 of 2)

4.5 CALIBRATION

a. General

The Gould Frequency Converter, Model 13-4618-20, has been accurately calibrated before shipment from the factory and should give long trouble free service. Should recalibration be required, it should be performed by qualified technical personnel only.

CAUTION: CALIBRATION SHOULD NOT BE ATTEMPTED UNLESS SUITABLE, SPECIFIED TEST EQUIPMENT IS USED. SINCE SPECIAL, HIGH PRECISION EQUIPMENT IS REQUIRED, IT IS RECOMMENDED THAT THIS MODEL BE RETURNED TO THE FACTORY FOR RECALIBRATION.

NOTE: Performance checks in this sectiion specify limitations based on optimum "new-equipment" values. Should any results be unacceptable, please see the troubleshooting section of this manual or your Gould Service Representative.

b. Test Equipment Required

The following is a list of test equipment necessary for calibration.

1. Extender card and cable assembly, Gould P/N 887291.
2. Digital Voltmeter: Fluke 8300A or equal.
3. Precision Frequency Source 40 to 500Hz ±0.001 Hz, minimum amplitude 10 volt rms with zero crossover.
4. Oscilloscope: Tektronix Model 453 or equal.
5. 2000 Series Recorder.
6. Two Function Generators — Wavetek Model 111 or equal.

c. Preliminary Procedure

1. Remove right side cover from preamp (Figure 4-1).

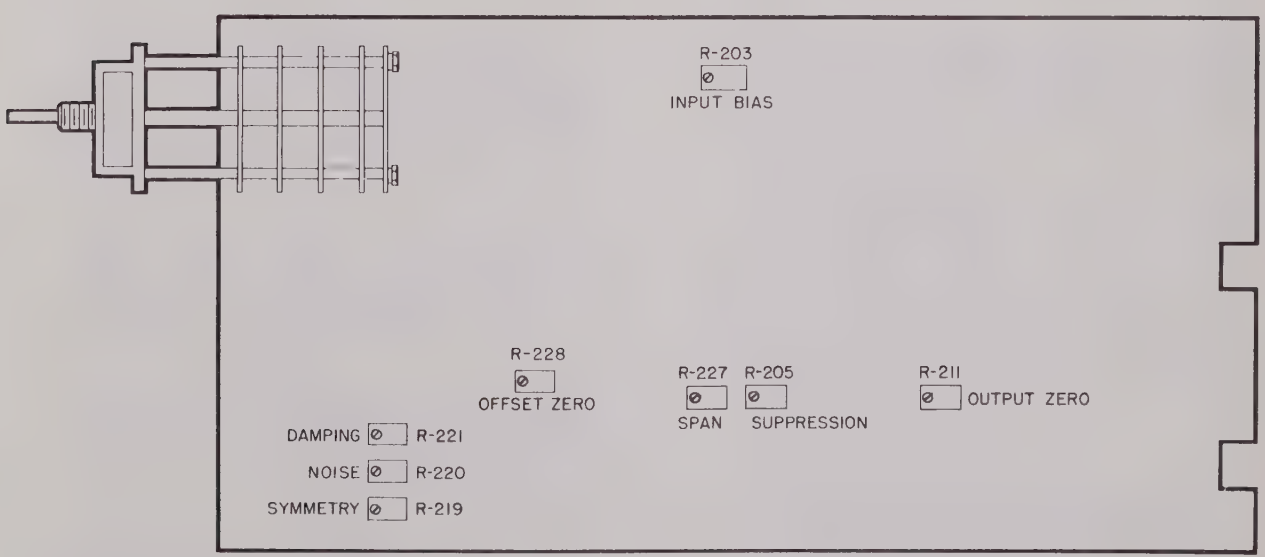


FIGURE 4-2 CALIBRATION CONTROLS

2. Set Front Panel controls as follows:

   KHz Full Scale Switch – OFF
   Zero Suppression Switch – OFF
   Zero Suppression Control – Fully CCW
   Input Offset Switch – OFF
   Sensitivity X1 Control – Fully CW
   Range Switch – X.1 position

3. Connect a 2K ohm resistor to pins 2 and 5 of p.c. edge connector.

4. Connect preamplifier to power source: +15 vdc and 13vrms or power from Gould 2000 Series Recorder.

5. Allow unit to warm up for 15 minutes.

6. Short pins 6 and 7 on input connector P-101 and apply signals to pins 1 (High) and 2 (low) of P-101.

d. Procedure

1. Output Zero Adjust (R-211)
   Connect a digital voltmeter to TP6 (Hi) and TP5 (Low). Adjust R211 for 0 ±.005 vdc reading.

2. Offset Zero Adjust (R-228)
   Apply a 50Hz ±0.005 Hz square wave, 10 vp-p with a zero crossover to input connector. Set KHz Full Scale Switch to .5 position and range to X1. Adjust R228 for 0.5 ±.005 vdc reading.

3. Span Control (R-227)
   Change input to 500 ±0.05 Hz and adjust R227 for 5 ±.005vdc reading. Repeat steps 2 and 3 to eliminate interaction.

4. Noise Control (R-220)
   Change frequency to 50Hz and connect scope to TP4 (High) and TP5 (Low). Adjust R220 for minimum noise with 5mv/div scope setting.

5. Symmetry Control (R-219)
   Connect the scope to TP6 (High) and TP5 (GND). Set the KHz Full Scale Switch to 10.

   Synchronously switch the input frequency from 1KHz to 10KHz at a rep rate of 50Hz and observe the rise and fall time on the scope.

   Adjust R219 for equal rise and fall times within .1 M.S. rise and fall time is to be measured at the 10 and 90% points of the wave form on the scope.

6. Damping Adjust (R221)
   Adjust the Damping Control so that the rise time is 1.8 ms ±.1 ms.

   Set the KHz Full Scale Switch to .1 and switch the input frequency from 10Hz to 100Hz at a rep rate of .5Hz.

   Run the recorder at 200mm/sec and measure the rise time. It should be less than 200ms.

7. Input Bias Adjust (R203)
   Connect a 10mv rms 50 KHz sinewave to the input. Connect a scope to TP5 (GND) and TP3 (+Volts).

   Adjust the input bais control so that the 50 KHz square wave displayed on the scope is symmetrical within ±5%.

8. Zero Suppression Adjust (R-205)
   Apply the 100Hz +.01% frequency to the input. The DVM output should be 5 ±.01 volts.

   Turn the Zero Suppression Switch (S102) on the front panel to "on" and adjust the zero suppression (S103) on the front panel to 100%.

   Turn the Zero Suppression Adjust so that the DVM reads 0 ±5mv.

4.6 PREAMPLIFIER CHECKOUT PROCEDURE

a. Set the front panel controls as outlined in para. 4.5, C, 2.

b. KHz Full Scale Switch (S201)

1) Connect a dvm to the output, Pin5 (GND) and Pin 2 (High) of p.c. edge connector.

2) With the KHz Full Scale Switch in the OFF position and the range switch in the X.1 position the output read on the dvm should be 0 ±.01 volts.

3) Turn the range switch to X1 and the KHz Full Scale Switch to 50.

4) Apply a 50 ±.05KHz square wave with a 10V P to P amplitude and a zero crossover to the input. The DVM should read 5 ±.01 volts.

5) Repeat step 4 with various frequencies corresponding to the KHz Full Scale Switch settings.

c. Zero Suppression Control (R-103)

1) Connect a 500HZ ±.5 Hz square wave with a 10V P to P amplitude to the input. Set the KHz full scale switch to .5. The DVM should read 5 ±.01 volts.

2) Turn the Zero Suppression Switch (S102) "ON" and adjust the zero suppression so that the DVM reads 3.75, 2.50, 1.25 and 0 ±.01 volts. The suppression dial should read 25, 50, 75 and 100 ±2.5 divisions respectively.

d. Range Switch (S103)

1) Adjust the zero suppression so that the DVM output is .5 ±.001 volts. Turn the range switch to X.5, X.2 and X.1 positions.

2) The DVM should read 1, ±.004, 2.5 + .010 and 5 ±.020 volts respectively.

3) Turn the zero suppression switch to OFF and the range switch to X1.

e. Sensitivity Control (R104)

1) Turn the Sensitivity Control fully counterclockwise. The DVM reading should change from 5 volts to less than 2 volts.

2) Set the Sensitivity Control fully clockwise to the X1 position.

f. Input Offset Control (R102)

1) Connect a 200Hz ±1% sinusoidal signal to the input and monitor it with a scope. Adjust the signal amplitude to 40MV peak to peak and a zero dc crossover. The DVM should read 2 ±.05 volts.

2) Reduce the signal amplitude until the DVM voltage drops to less than .5 volts. The amplitude of the signal on the scope should be less than 28mv peak to peak.

3) Set the input bias switch to "ON" and turn the input bias control fully clockwise. The DVM should be reading less than .5V dc.

4) Adjust the signal amplitude to 28mv peak to peak and set the scope to read .5 volts per division. Increase the dc crossover plus bias on the input signal until the DVM reads 2 volts ±.05 volts. The dc level change on the scope should be at least +1V.

5) Repeat 4.6.4 with a negative bias. The dc level change on the scope should be at least −1V.

6) Turn the input offset switch to OFF.

g. Auxiliary Input

1) Measure the short circuit current between pins 4 and 5 of the input connector. It should be 54.5ma ±10%.

2) Repeat for pins 6 and 7, it should be .12ma ±10%.

4.7 SYSTEM CHECKOUT (CONVERTER AND GOULD 2000 SERIES RECORDER)

a. Rise Time

1) Connect two waveteks so that one VCG's the other. Connect the VCG wavetek to the input.

2) Monitor the converter output on the 2000 recorder. Set the modulated wavetek to 250Hz sine wave with an amplitude of ±5V and the other to a square wave with a rep rate of .5Hz. Adjust the waveteks to display a 10 to 100% square wave on the recorder.

3) The rise time on the recorder should be less than 200ms.

b. Linearity

1) Change the modulating wavetek to a ramp function with rep rate of .5Hz. Adjust the waveteks to display a 0 to 100% ramp on the recorder.

2) The non-linearity should be less than .1% between the 10% and 100% levels. Below 10% the noise level will increase.

SECTION V

THEORY OF OPERATION

5.1 BLOCK DESCRIPTION

The Gould Frequency to Voltage Converter, Model 13-4618-20, is a single channel plug-in signal conditioner, designed to be compatible with the 2000 Series Recorder line. The input frequency is converted to a 0 to 5 volt dc voltage proportional to the 0 to KHz full scale range switch on the front panel.

Figure 5-1 is a simplified block diagram of the system. The unit is designed to monitor frequencies from 0 to 50KHz. The input amplitude conditioner accepts any amplitude from 10mv to 500V RMS and produces a 10ma square wave drive for the optical coupler. The 2500 volt optical coupler isolates the input from the output signal and provides a 5 volt amplitude frequency. proportional to the input frequency, to the input of the phase detector.

The phase detector, filter and voltage controlled oscillator comprise a servo loop and is commonly referred to as a phase locked loop (PLL). The phase detector compares the input command frequency with the feedback frequency and produces a pulse porportional to the phase difference between the two signals. This signal is filtered and applied to the voltage controlled oscillator which converts the dc level to a frequency which is used as the feedback. When the phase and frequency of the command and feedback frequencies are equal the pulse duration goes to zero and the output of the filter is held at the required voltage to produce the feedback frequency.

The output signal conditioner monitors the voltage at the filter output and provides additional filtering, gain change and zero suppression for the converter output.

A more detailed block diagram is provided as a troubleshooting aid in Section 4, Figure 4-1.

5.2 Circuit Description

a. Input Signal Conditioner

Drawing 289287 is the schematic of the converter. Power for the isolated front end is obtained from transformer T201, diode bridge CR209 and filter capacitors C203 and C204. U201-3 and 4 constitute a precision ±6 volt reference for adjusting input offset voltages.

The input voltage is applied to terminals J101-1 and 2 across a 100K, 8W resistor. Diodes CR201 and CR202 clip voltage amplitude in excess of ±.7 volts. The upper limit for input voltage amplitude is determined by the 100K 8W input resistor. U201-1 and its associated components provide amplification for low level signals. The output is limited by diodes CR203 and CR204 to a maximum of approximately 1.4 volts. U-201-2 and its components act as a Schmitt drive of about 10ma to the diode of the optical coupler. R203 adjusts the input bias level to guarantee operation with a minimum signal of ±10mv from a zero level. The front panel input offset adjusts the minimum level from 0 to ±1 volt dc. When using the isolated input J101-1 and 2, J101-6 and 7 should be shortened.

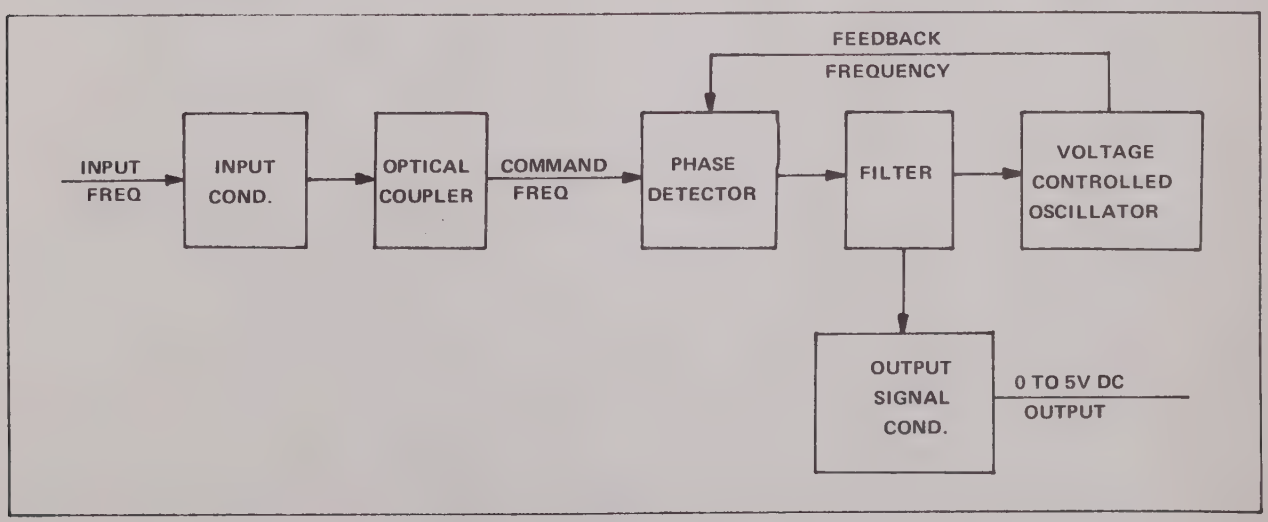


FIGURE 5-1 BLOCK DIAGRAM

b. Optical Coupler and Phase Locked Loop

With J101-6 and 7 shorted, the voltage at U203-4 pin 14 is approximately +5 volts. The optical coupler transistor turns transistor Q201 on and off at a repetition rate proportional to the input frequency. This signal is fed to frequency divider U204. The KHz full scale switch, S201, sets U204 to divide by 5, 2 or 1. The output frequency of U204 is conditioned by Q202 and is the command frequency to phase detector U205. U206-1 and 2 with their associated components constitute the filter section. Diodes CR210 and 211 prevent the output of U206-1 from going negative. This limits the outputto approximately zero for zero frequency input. The voltage controlled oscillator, U209, and its associated components converts the 0 to 5 volt level at its input to a proportional 0 to 10 KHz frequency. U207 and U208 divide this frequency by either 100, 10 or 1 depending on the setting of the KHz full scale switch, S201, on the front panel. The output frequency from U207 is conditioned by transistor Q203 and becomes the feedback frequency to the phase detector, U205.

c. Output Singal Conditioner

U206-3 and 4 buffer the 0 to 5V dc signal on the input to the voltage controlled oscillator U209 and provide additional filtering for a low noise output signal. The output stage U203-3 sums both the signal from the sensitivity pot and the 0 to 100% zero suppression from U203-2. The range swtich in the feedback of this amplifier allows expansion of the frequency range about the suppressed signal output.

d. Auxiliary Input Circuit

In addition to the normal isoalted input on J101-1 and 2 an auxiliary input is provided for use with externally mounted optical couplers. When using this input pin J101-1 and 3 are shorted together. Pins J101-5 and 4 supply approximately 50ma of current to energize the optical coupler diode. Pins J101-6 and 7 are connected to the light sensitive transistor of the coupler. Note that J101-6 is negative with respect to 7 and J101-5 is negative with respect to J101-4.

SECTION VI

PARTS IDENTIFICATION

This equipment has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Gould Service Engineer listed on the warranty card shipped with the equipment.

The following parts lists and schematic diagrams are designed to assist in servicing and repairing the equipment. For replacement parts, refer to the appropriate figures and parts lists in this section. The items listed present the lowest assembly or part, but do not necessarily imply the are for sale.

Contact your local service branch for availability of salable components, assemblies or parts.

To assure prompt and satisfactory delivery of replacement parts, include the following with the purchase order:

1. Name and model number of the instrument.
2. Description of the part as listed in the manual.
3. Gould part number.

NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.

ASSEMBLY PARTS LIST
FREQUENCY CONVERTER, MODEL 13-4618-20
FIGURE 6-1

ITEM NUMBER	PART NUMBER	DESCRIPTION	REF. DESIG.
1	789237	Panel Assy, Front	
2	285652-2	Knob	
3	663800-1	Knurled Nut	
4	284990	Knob, Turns Counting	
5	285650	Knob	
6	285651-3	Knob	
7	285652-1	Knob	
8	689681	Knob	
9	685944-1	Frame, Bottom	P-201
10	9-281501-6	Connector	P-202
	281506-1	Contact (Used in P-202)	P-203
	281502-1	Contact (Used in P-201, P-203)	
11	785946	Panel Assy, Rear	
12	689658	Connector Assy	J-101
13	1-289255-104	Resistor	R-101
14	889657	Board Assy (See Fig. 5-2)	
15	689338	Frame, Top	
16	285943	Cover, Side	
17	268923	Switch, Toggle	S-101, S-102
18	230050-202	Resistor, Variable	R-103
19	10-286044-103	Resistor, Variable	R-102
20	10-286044-152	Resistor, Variable	R-104
21	286151-6	Switch, Rotary	S-103
22	686421	Cover Assy, Left (not shown)	

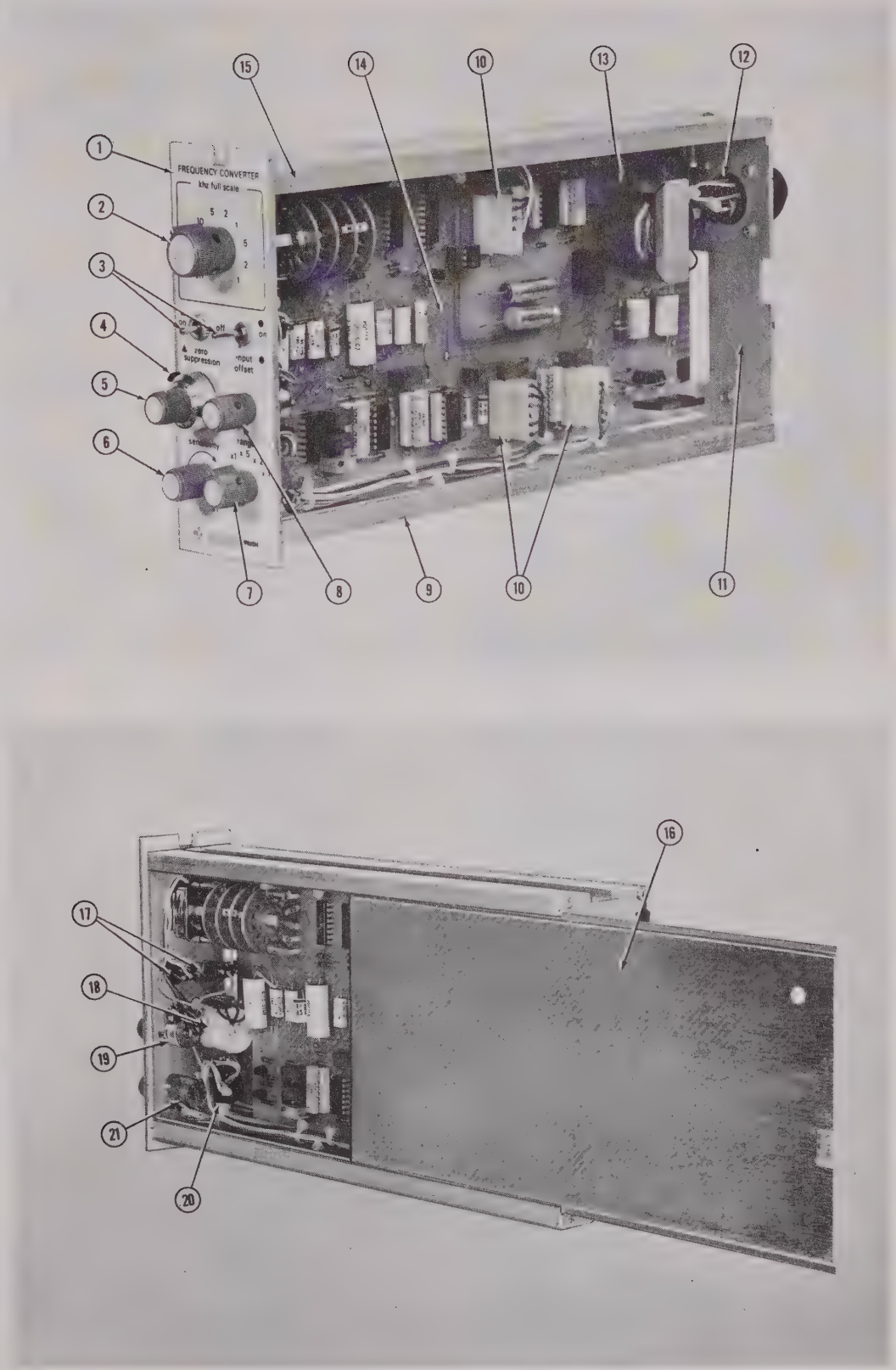


FIGURE 6-1 FREQUENCY CONVERTER

ELECTRICAL PARTS LIST
BOARD ASSEMBLY 889657
FIGURE 6-2

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C201	288755-103	Capacitor, .01uf
C202	288755-103	Capacitor, .01uf
C203	231922-107	Capacitor, 100uf
C204	231922-107	Capacitor, 100uf
C205	5-241145-105	Capacitor, 1uf
C206	5-125904-503	Capacitor, .05uf
C207	5-125904-104	Capacitor, .1uf
C208	5-125904-103	Capacitor, .01uf
C209	5-241145-105	Capacitor, 1uf
C210	5-125904-503	Capacitor, .05uf
C211	5-125904-104	Capacitor, .1uf
C212	5-125904-103	Capacitor, .01uf
C213	288755-103	Capacitor, .01uf
C214	288755-103	Capacitor, .01uf
C216	288755-103	Capacitor, .01uf
C217	288755-103	Capacitor, .01uf
C218	288755-103	Capacitor, .01uf
C219	288755-103	Capacitor, .01uf
C220	10-247116-103	Capacitor, .01uf
C221	288755-103	Capacitor, .01uf
C222	5-287730-332	Capacitor, .033uf
C223	288755-103	Capacitor, .01uf
C224	262585-106	Capacitor, 10uf
C225	262585-106	Capacitor, 10uf
C226	10-241145-334	Capacitor, 3.3uf
C227	10-241145-334	Capacitor, 3.3uf
C228	288755-103	Capacitor, .01uf
C229	288755-103	Capacitor, .01uf
C230	287614-102	Capacitor, .001uf
CR201	280440	Diode,1N 4148
CR202	280440	Diode, 1N4148
CR203	280440	Diode, 1N 4148
CR204	280440	Diode,1N 4148
CR205	280440	Diode, 1N 4148
CR206	280440	Diode, 1N 4148
CR207	280440	Diode, 1N 4148
CR208	283166-1	Diode, 1N 4576
CR209	286018-2	Diode, Bridge, MDA 104
CR210	280440	Diode, 1N 4148
CR211	280440	Diode, 1N 4148
CR212	241133	Diode, 1N 751A
CR213	130198-1	Diode, 1N 2071

ELECTRICAL PARTS LIST
BOARD ASSEMBLY 889657
FIGURE 6-2 (Continued)

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
E1 thru E8	265763-3	Contact, Elec.
E9 & E10	265154	Contact, Elec.
J201 thru J203	281711-6	Connector
Q201 thru Q203	286141	Transistor, 2N 3904
R201	5-241111-514	Resistor 510K ± 5%
R203	269085-502	Resistor, Variable 5K
R205	269085-202	Resistor, Variable 2K
R206	5-115558-221	Resistor, 220 ohm ± 5%
R209	5-241111-471	Resistor, 470 ohm ± 5%
R210	5-241111-472	Resistor, 4.7K ± 5%
R211	269085-502	Resistor, Variable 5K
R212	R1-284694-10000	Resistor, 1K ± .1%
R213	R1-284694-613R7	Resistor, 613.7 ohm ± .1%
R214	R1-284694-203R9	Resistor, 203.9 ohm ± .1%
R215	R1-284694-202R8	Resistor, 202.8 ohm ± .1%
R216	5-241111-103	Resistor, 10K ± 5%
R217	5-241111-203	Resistor, 20K ± 5%
R218	5-241111-202	Resistor 2K ± 5%
R219	269085-103	Resistor, Variable, 10K
R220	269085-202	Resistor, Variable, 2K
R221	269085-203	Resistor, Variable, 20K
R222	5-241111-202	Resistor, 2K ± 5%
R223	5-241111-203	Resistor, 20K ± 5%
R224	5-241111-103	Resistor, 10K ± 5%
R225	5-241111-103	Resistor, 10K ± 5%
R226	5-241111-103	Resistor, 10K ± 5%
R227	269085-502	Resistor, Variable 5K
R228	269085-502	Resistor, Variable 5K
R229	5-115558-121	Resistor, 120 ohm ± 5%
R230	5-241111-513	Resistor, 51K ± 5%
S201	289195	Switch, Rotary
T201	288304	Transformer
U201	287487	Integrated Circuit, 3403
U202	285589-1	Integrated Circuit, 4N25
U203	287487	Integrated Circuit, 3403
U204	284691	Integrated Circuit, 4017
U205	287901	Integrated Circuit, 4044

ELECTRICAL PARTS LIST
BOARD ASSEMBLY 889657
FIGURE 6-2 (Continued)

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
U206	287487	Integrated Circuit, 3403
U207	284691	Integrated Circuit, 4017
U208	284691	Integrated Circuit, 4017
U209	289260	Integrated Circuit, 8400
U210	287498	Voltage Reg., 7812
U211	287496	Voltage Reg., 7912
U212	289199	Resistor, Network
U213	289198	Resistor, Network
U214	289200	Resistor, Network
U215	289197	Resistor, Network
U216	289196	Resistor, Network

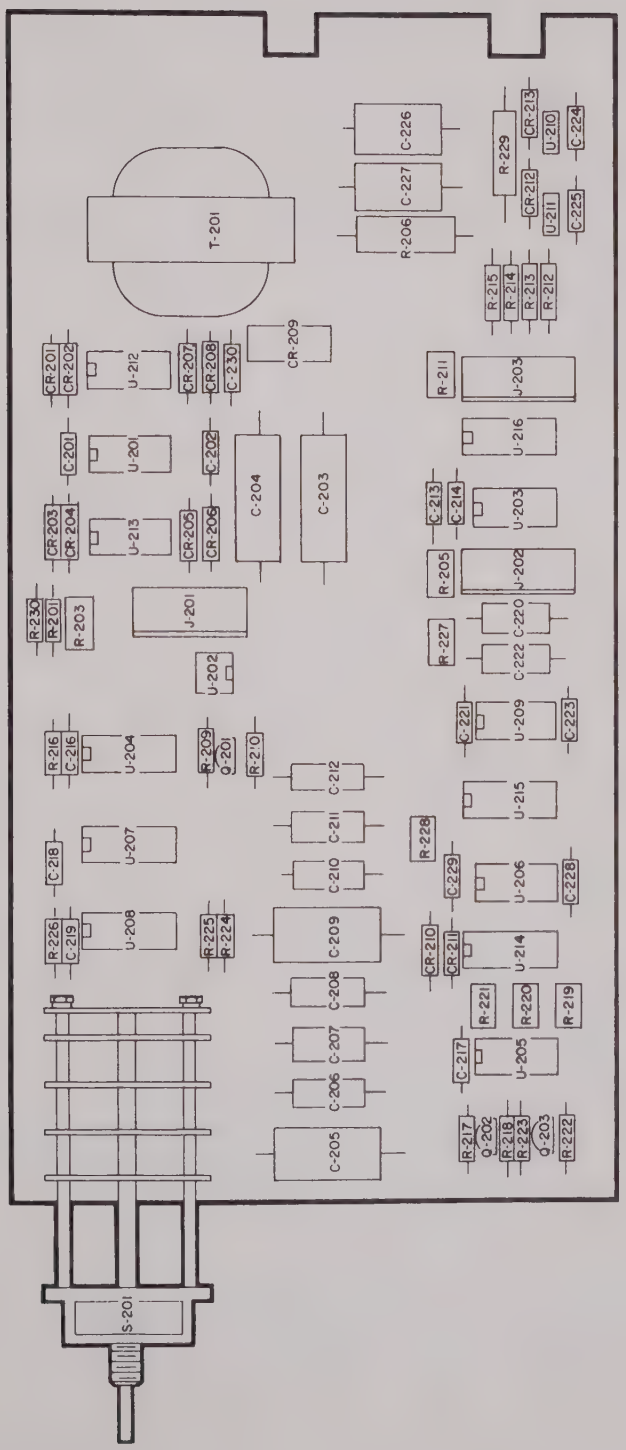
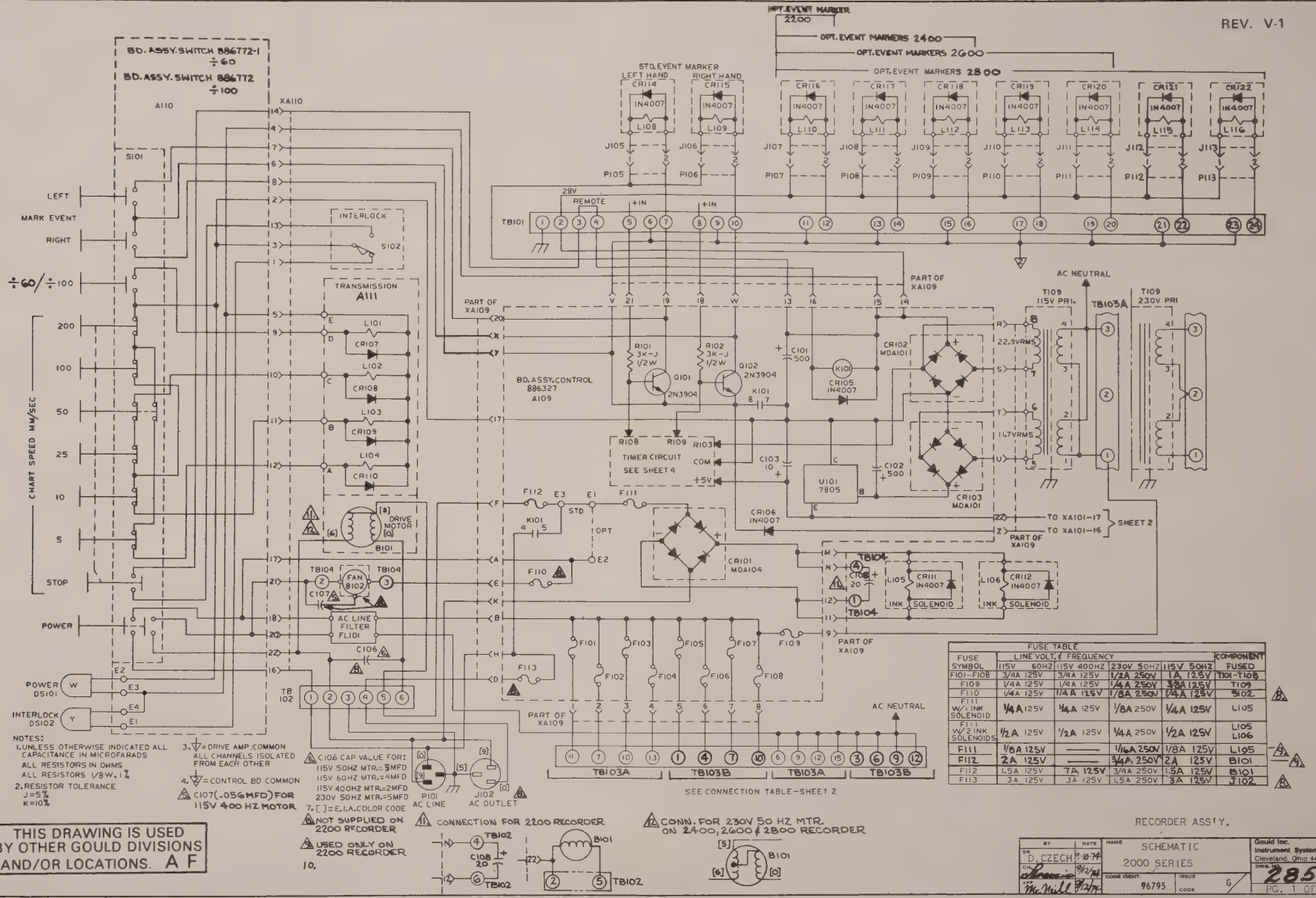


FIGURE 6-2 BOARD ASSEMBLY 889657



NOTES:
1. UNLESS OTHERWISE INDICATED ALL CAPACITANCE IN MICROFARADS
ALL RESISTORS IN OHMS
ALL RESISTORS 1/8W, 1%
2. RESISTOR TOLERANCE
J=5%
K=10%
3. ▽ = DRIVE AMP COMMON ALL CHANNELS ISOLATED FROM EACH OTHER
4. ▽ = CONTROL BD COMMON
5. C107(.05 MFD) FOR 115V 400 HZ MOTOR
6. C106 CAP VALUE FOR:
115V 50HZ MTR.=3MFD
115V 60HZ MTR.=4MFD
115V 400HZ MTR.=2MFD
230V 50HZ MTR.=5MFD
7. [ ]=E.I.A. COLOR CODE
8. NOT SUPPLIED ON 2200 RECORDER
9. USED ONLY ON 2200 RECORDER
10. CONNECTION FOR 2200 RECORDER
11. CONN. FOR 230V 50 HZ MTR. ON 2400, 2600 & 2800 RECORDER

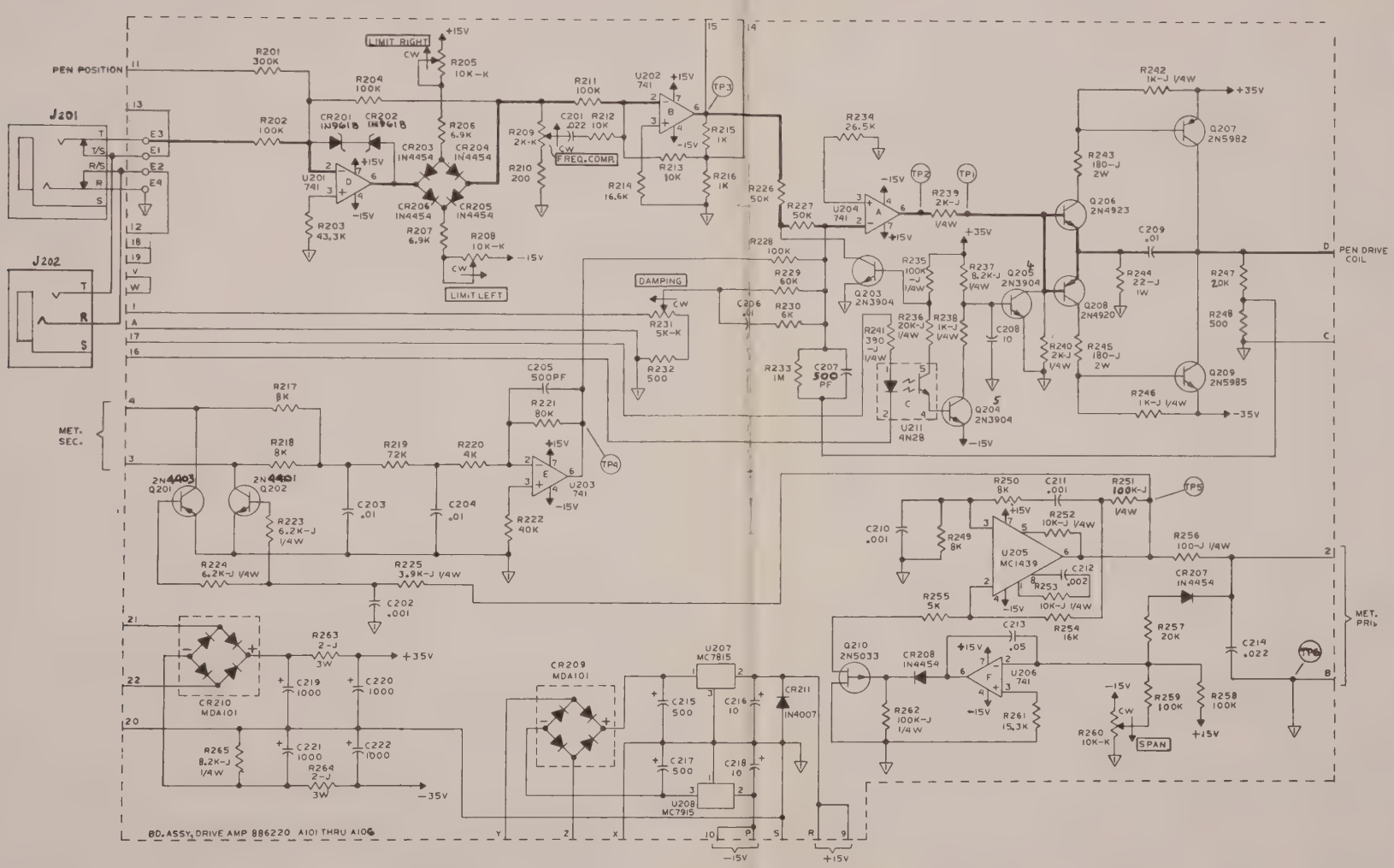
FUSE TABLE

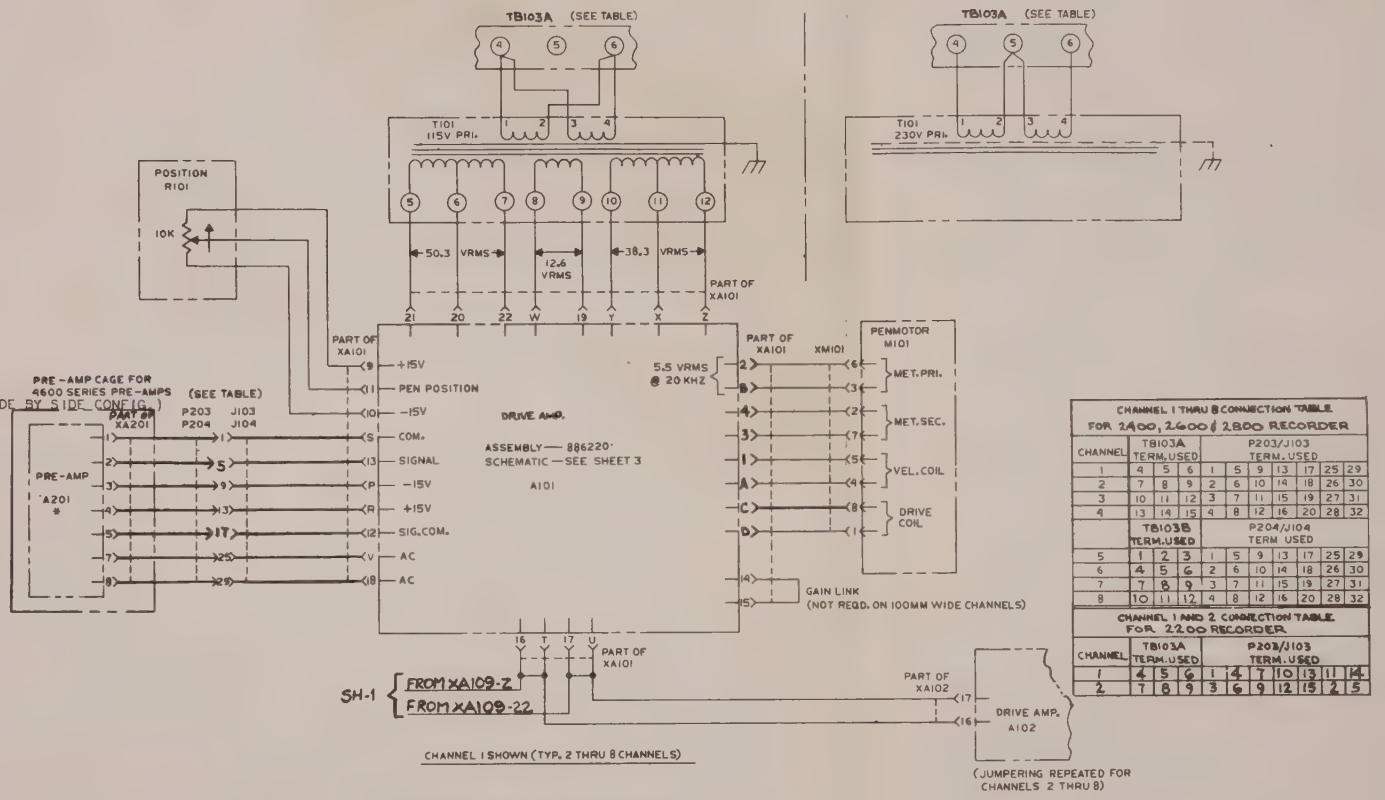
FUSE SYMBOL	LINE VOLT. & FREQUENCY 115V 60HZ	115V 400HZ	230V 50HZ	115V 50HZ	COMPONENT FUSED
F101-F108	3/4A 125V	3/4A 125V	1/2A 250V	1A 125V	T101-T108
F109	1/4A 125V	1/4A 125V	1/4A 250V	3/8A 125V	T109
F110	1/4A 125V	1/4A 125V	1/8A 250V	1/4A 125V	S102
F111 W/ INK SOLENOID	1/4A 125V	1/4A 125V	1/8A 250V	1/4A 125V	L105
F111 W/ 2 INK SOLENOIDS	1/2A 125V	1/2A 125V	1/4A 250V	1/2A 125V	L105 L106
F111	1/8A 125V	—	1/16A 250V	1/8A 125V	L105
F112	2A 125V	—	3/4A 250V	2A 125V	B101
F112	1.5A 125V	1.5A 125V	3/4A 250V	1.5A 125V	B101
F113	3A 125V	3A 125V	1.5A 250V	3A 125V	J102

THIS DRAWING IS USED BY OTHER GOULD DIVISIONS AND/OR LOCATIONS. A F

RECORDER ASS'Y.

BY	DATE	NAME	SCHEMATIC 2000 SERIES	Gould Inc. Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
DR D. CZECH	9-10-74			
CH	9/12/74	CODE IDENT. 96795	ISSUE CODE G	DWG. NO. 28585
	9/12/74			PG. 1 OF 4


REVISIONS
SYM. DESCRIPTION DATE APPROVAL
PEN POSITION
J201
J202
LIMIT RIGHT
LIMIT LEFT
FREQ. COMP.
DAMPING
SPAN
PEN DRIVE COIL
MET. SEC.
MET. PRI.
BD. ASSY. DRIVE AMP 886220 A101 THRU A106
THIS DRAWING IS USED BY OTHER GOULD DIVISIONS AND/OR LOCATIONS. A F
RECORDER ASS'Y.
SCHEMATIC
2000 SERIES
Gould Inc.
Instrument Systems Division
Cleveland, Ohio 44114 U.S.A.
285851
PG. 3 OF 4
C. CZECH 9-10-74
96795



CHANNEL 1 THRU 8 CONNECTION TABLE FOR 2400, 2600 & 2800 RECORDER											
CHANNEL	TB103A TERM. USED			P203/J103 TERM. USED							
1	4	5	6	1	5	9	13	17	25	29	
2	7	8	9	2	6	10	14	18	26	30	
3	10	11	12	3	7	11	15	19	27	31	
4	13	14	15	4	8	12	16	20	28	32	
	TB103B TERM. USED			P204/J104 TERM USED							
5	1	2	3	1	5	9	13	17	25	29	
6	4	5	6	2	6	10	14	18	26	30	
7	7	8	9	3	7	11	15	19	27	31	
8	10	11	12	4	8	12	16	20	28	32	

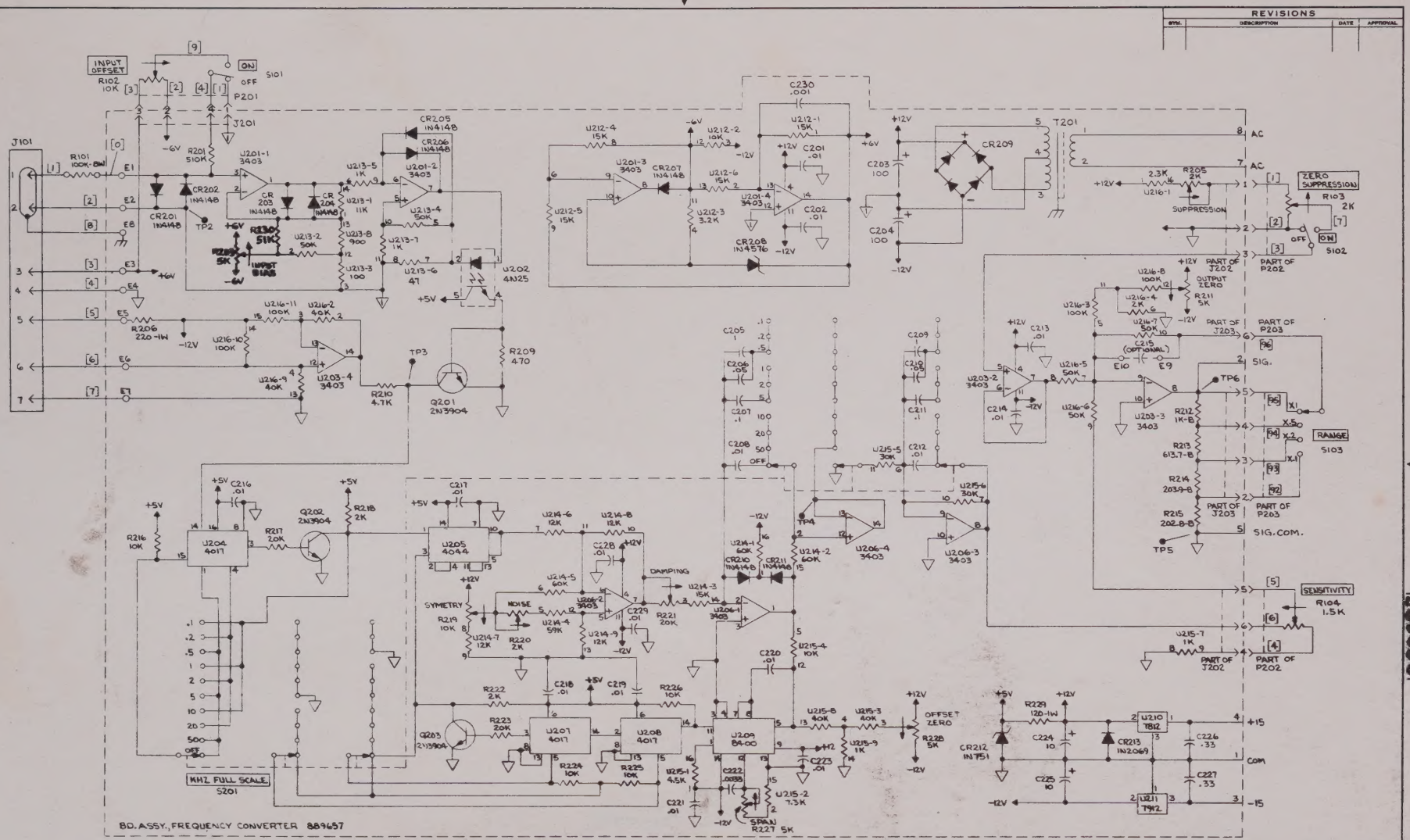
CHANNEL 1 AND 2 CONNECTION TABLE FOR 2200 RECORDER										
CHANNEL	TB103A TERM. USED			P203/J103 TERM. USED						
1	4	5	6	1	4	7	10	13	11	14
2	7	8	9	3	6	9	12	15	2	5

* FOR 6 & 8 CH. RECORDER RACK MOUNTED CONFIGURATION, SEE WIRING DIAGRAM 292226 (11-1202-15) FOR PREAMP TO DR. AMP. WIRING.

RECORDER ASS'Y.

THIS DRAWING IS USED BY OTHER GOULD DIVISIONS AND/OR LOCATIONS. A F

BY	DATE	NAME	SCHEMATIC 2000 SERIES	Gould Inc. Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
D. CZECH	9-10-74			
		CODE IDENT 96795	ISSUE CODE G	DWG NO 285851
				PG. 2 OF 4


REVISIONS
INPUT OFFSET
R102 10K
S101
ON
OFF
P201
J201
J101
R101 100K-2W
R201 510K
CR202 IN4148
CR201 IN4148
TP2
CR203 IN4148
CR204 IN4148
CR205 IN4148
CR206 IN4148
U201-1 3403
U201-2 3403
U213-1 11K
U213-2 50K
U213-3 100
U213-4 50K
U213-5 1K
U213-6 47
U213-7 1K
U213-8 900
R130 51K
R202 5K
INPUT BIAS
U202 4N25
R209 470
Q201 2N3904
R210 4.7K
TP3
R206 220-1W
U216-11 100K
U216-10 100K
U216-2 40K
U216-9 40K
U203-4 3403
E1
E2
E8
E3
E4
E5
E6
E7
+6V
-6V
-12V
+5V
C230 .001
U212-1 15K
U212-2 10K
U212-3 3.2K
U212-4 15K
U212-5 15K
U212-6 15K
U201-3 3403
U201-4 3403
CR207 IN4148
CR208 IN4576
C201 .01
C202 .01
C203 100
C204 100
T201
CR209
AC
2.3K
R205 2M
SUPPRESSION
U216-1
ZERO SUPPRESSION
R103 2K
S102
PART OF J202
PART OF P202
U216-8 100K
U216-4 2K
U216-3 100K
OUTPUT ZERO
R211 5K
U216-7 50K
C215 (OPTIONAL)
PART OF J203
PART OF P203
SIG.
U216-5 50K
U216-6 50K
U203-2 3403
U203-3 3403
C214 .01
C213 .01
E10
E9
TP6
TP5
R212 1K-B
R213 613.7-B
R214 2039-B
R215 202.8-B
X1
X.5
X.2
RANGE
S103
SIG.COM.
C205
C206 .05
C207 .1
C208 .01
C209
C210 .05
C211 .1
C212 .01
OFF
U215-5 30K
U215-6 30K
U206-3 3403
U206-4 3403
TP4
U214-1 60K
U214-2 60K
CR210 IN4148
CR211 IN4148
DAMPING
U214-3 15K
U214-5 60K
U206-2 3403
U206-1 3403
C228 .01
C229 .01
SYMETRY
NOISE
R219 10K
R220 2K
R221 20K
U214-4 59K
U214-7 12K
U214-6 12K
U214-8 18K
U204 4017
U205 4044
R216 10K
R217 20K
Q202 2N3904
R218 2K
C216 .01
C217 .01
.1
.2
.5
1
2
5
10
20
500
OFF
KHZ FULL SCALE
S201
C218 .01
C219 .01
R222 2K
R223 20K
R224 10K
R225 10K
R226 10K
Q203 2N3904
U207 4017
U208 4017
U209 84-00
U215-1 4.5K
U215-2 7.3K
U215-3 40K
U215-4 10K
U215-7 1K
U215-8 40K
U215-9 1K
C220 .01
C221 .01
C222 .0033
C223 .01
SPAN R227 5K
OFFSET ZERO
R228 5K
C224 10
C225 10
C226 .33
C227 .33
R229 120-1W
CR212 IN751
CR213 IN2069
U210 7812
U211 7912
+15
COM
-15
BD. ASSY., FREQUENCY CONVERTER 889657
NOTES:
1. UNLESS OTHERWISE INDICATED:
ALL CAPACITANCE IN MICROFARADS
ALL RESISTORS IN OHMS
ALL RESISTORS 1/4 W, .25%
2. [ ] = FRONT PANEL CONTROL
3. ARROW INDICATE CW ROTATION
4. [ ] = E.I.A. COLOR CODE
AMPLIFIER ASSY., FREQUENCY CONVERTER
SCHEMATIC
MODEL NO. 13-4618-20
96795
Instrument Systems Division
Cleveland, Ohio 44114 U.S.A.
889287

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